Weather Station Inventory and Preliminary Needs Assessment for the Northeast Coastal and Barrier Network

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INTRODUCTION

Weather and climate play significant roles in shaping both physical and biotic resources. Short and medium term weather conditions, for example, can affect local and regional movement of geologic materials and plant pollen and seeds, as well as animal behavior. Longer term weather and climatic patterns are among the most important factors shaping the structure of landforms, water resources, and ecosystems. Long term weather data sets can be important for the interpretation of results from long term monitoring of natural resources. Even if not considered an essential component to the study design, weather data provides the potential for long term correlations with observed physical and biologic patterns. The relative proximity of weather stations to the resources being monitored can be important to the interpretation of resource and weather data, and depends upon the project as well as the spatial and temporal variability of local and regional weather.

The Northeast Coastal and Barrier Network's (NCBN) vital signs monitoring program will establish monitoring projects in eight Atlantic coastal parks. Monitoring programs for which weather data may be valuable include estuarine water quality, coastal geomorphology, land cover change, and salt marsh vegetation, nekton, and elevation. This report provides an assessment of historic and current weather data collection in and around the parks of the NCBN as well as guidance for weather station setup, data collection, and data management.

SITE VISITS

Scoping visits were conducted from October 6 to October 17, 2003 to the 8 parks of the Northeast Coastal and Barrier Network. The purpose of the visits was to ascertain the status of any weather instrumentation, to gather information on any historic or current weather data, and to assess the interest and needs for weather information, especially as related to long term monitoring. The park units visited were:

October 6	Cape Cod National Seashore
October 7	Fire Island National Seashore
October 8	Sagamore Hill National Historic Site
October 9	Sandy Hook unit of Gateway National Recreation Area
October 9	Staten Island unit of Gateway National Recreation Area
October 10	Jamaica Bay unit of Gateway National Recreation Area
October 14	George Washington Birthplace National Monument
October 14	Thomas Stone National Historic Site
October 15-16	Assateague Island National Seashore
October 17	Colonial National Historic Park

CAPE COD NATIONAL SEASHORE

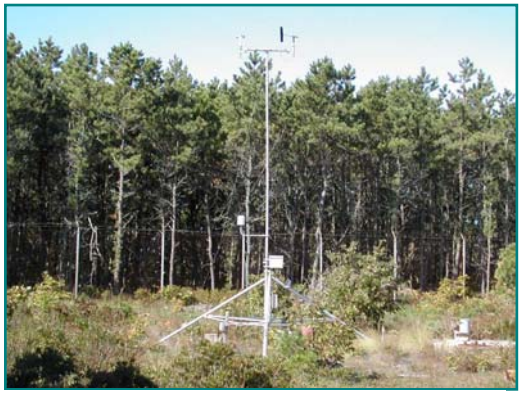
I spoke to several people at Cape Cod, both at the North Atlantic Coastal Lab and at the Fire Management Office in Wellfleet: Jon Budreski, Krista Lee, Dave Vinson, Steve Smith, Bob Cook, and Dave Crary. The principal site where weather data are being collected is at Truro, where there are two weather stations operating independently. One is run by the Fire Management Office in the person of Dave Crary, the other is run by the state of Massachusetts. The data for both go out via phone lines to the respective offices. Data collected at both stations are wind speed and direction, temperature, relative humidity, precipitation, and fuel moisture. In addition, at the state site there is a National Atmospheric Deposition Program (NADP) sampler and another similar device that samples for mercury. There are also rain gauges (made by Belfort), at Duck Pond (Wellfleet) and near the Salt Pond Visitor Center (Eastham). At the Wellfleet station there is also a hygrothermograph (combination temperature and relative humidity recorder) along with fuel moisture sticks.

The data from the Truro NPS station exist on the Weather Information Management System (WIMS) website for not much more than the recent year - previous data may or may not be available (http://famweb.nwcg.gov/wims/jsp/default.htm). The rainfall data from the NADP sampler are kept at the North Atlantic Coastal Lab along with additional rainfall data from the two Belfort rain gauges at Duck Pond and Salt Pond. The Belfort rain data have been entered into a spreadsheet for the last couple of years – before that they are only on the charts. Much of the older data appears to be scattered about on 3.5" floppies or on CDs. There also appears to be a problem with a change in software as far as accessing the older data. The state weather station has existed since 1987 and data since 1994 are apparently available at http://www.epa.gov/air/data.

A couple of problems typical of weather data collection were noted on site. The NPS tipping-bucket rain gauge was not mounted in a stable position, and the whole assembly could be easily tilted to and fro. The state tipping-bucket rain gauge was found to be loosely mounted on a post, not securely attached, and had the funnel top clogged with debris with rainwater on top. This is a typical example of the importance of on-site inspection and maintenance.

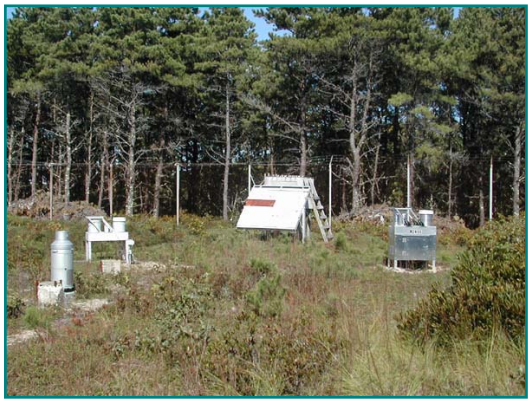
Other sources: There are NOAA stations at Provincetown Airport and at Chatham Airport. The data are available on the internet in the form of daily max/min/avg temperatures, precipitation, wind speed/direction, etc.. http://www.erh.noaa.gov. These two stations are at either end of the Seashore and some distance from Truro. Of interest also is the existence of private weather stations that report current conditions, available on the internet. One such station is at the Oyster Cove B&B – information and current data are available at http://www.telecamsystems.com. Much of the data from these systems is not archived, although some are, and can be found on the "weather underground" site http://www.wunderground.com.

Contacts: Dave Crary (NPS), John Paino (john.paino@state.ma.us) (508-946-2744), Ann Sorensen MA-DEP (ann.sorensen@state.ma.us) (978-975-1138 x335), Dave Johnson (Telecam Systems 508-252-4537).



NPS weather station at Truro, CACO

MA state weather station at Truro, CACO



NADP site at Truro, CACO

Belfort raingauge at Duck Pond, CACO

FIRE ISLAND NATIONAL SEASHORE

At Fire Island I met with Mike Bilecki, who took me out to an old weather station at Watch Hill. It has been defunct since 1996 and the location of the data is unknown, although it may be stored on discs somewhere at the facility shared by Resource Management and Maintenance. I then went to the Fire Island Lighthouse and found the weather station there, which is also defunct. According to Bruce Lane (currently of GATE) in 1982 this station was not functional, and the location of the data for that station is likewise unknown. Also, apparently there were data being collected at the William Floyd Estate until 8-10 years ago, although no additional information was available on these data. There is no NADP site at FIIS.

Other sources: The National Weather Service has an installation at the Brookhaven National Laboratory, about 15 miles north of the William Floyd Estate on the east side of FIIS. There are also data available from the Wertheim National Wildlife Refuge, which is just across Bellport Bay, near the FIIS Smith Point Visitor Center. The U.S. Coast Guard has facilities at Fire Island Inlet and at Moriches - no attempt was made to determine the extent of weather data collection at these facilities. Given the exposed nature of FIIS, there may be significant local variation in weather, and of these sites the USCG sites would likely best reflect conditions on the Fire Island itself.

Contacts: Mike Bilecki (NPS), Richard Stavdal (NPS), Jim Ebert (NPS-CAHA), Bruce Lane (NPS-GATE).

Defunct weather station at Watch Hill, FIIS

Defunct weather station at Watch Hill, FIS

Defunct weather station at Lighthouse, FIIS

Rusted raingauge at Lighthouse weather station, FIIS

SAGAMORE HILL NATIONAL HISTORIC SITE

At Sagamore Hill I spoke with Scott Gurney, who expressed great interest in the natural resource values of the site, and noted that the weather there can be quite different from coastal areas nearby, and even varies from one side of the hill to the other. There are no weather data being collected at Sagamore Hill.

Other sources: Weather data are possibly available from the Republic Airport in Farmingdale, NY (15 miles inland to the south), a NOAA station in Upton, NY (30 miles away), Caumsett State Park at Lloyd Neck, NY (6 miles away along the same coastal region), or Oyster Bay National Wildlife Refuge, which encompasses the waters off of the marsh at SAHI, and is headquartered in nearby Oyster Bay, NY.

Contacts: Scott Gurney (NPS)

GATEWAY NATIONAL RECREATION AREA - SANDY HOOK UNIT

I met Bruce Lane and Jeanne McArthur at Sandy Hook. There is a temperature gauge at the Ranger Station, with an abandoned fire weather station nearby. A rain gauge is in the residence area, and there was also a former NADP site. Neither the temperature nor rain data are apparently being recorded.

Other sources: NOAA has a station on the pier at the Coast Guard Station, with a tide gauge as well as instruments to collect wind speed and direction as well as air temperature. The Coast Guard contacts I spoke to were not familiar with the setup, and I did not attempt to contact NOAA. There was weather instrumentation on the roof of the USCG headquarters building, but it was defunct. There is also a National Weather Service site at Long Branch, NJ, across the bay. I was told that the Stevens Institute of Technology, based in Hoboken, NJ, wants to put in a coastal monitoring station for wind, waves, etc…

Contacts: Bruce Lane (NPS), Jeanne McArthur (NPS)

Abandoned fire weather station, Sandy Hook

Raingauge (only), Sandy Hook

NOAA station at U.S. Coast Guard Base, Sandy Hook

Defunct weather instruments at U.S. Coast Guard Base, Sandy Hook

GATEWAY NATIONAL RECREATION AREA - STATEN ISLAND

I went for a quick visit to Great Kills Park and met Steve Schiffer, who runs the Education Field Station there. On site, but not working (due to lightning strike?), was a good, inexpensive setup, made by Davis Instruments, that recorded wind speed/direction, precipitation, temperature, relative humidity, as well as water temperature and pH for a small pond nearby. It was a nice system, and was plugged into a computer for data logging, but upon climbing up on the roof I determined that the sending unit appeared to be fried. Steve seemed quite interested in getting it all working again, and spent some time with me as I tried to troubleshoot the problem.

I also met Kathryn Mellander, GIS Specialist, who was very interested in getting better site-specific weather information. I also talked to Patti Reilly, an education specialist, who shared this interest. There was no NADP site.

Other sources: The Northeast Regional Climate Center, run by Cornell University, maintains weather and climate data for many stations, including one at JFK International Airport. There are certainly many other sources for weather data in the greater New York City area, although these were not researched. It would be important to find sources that reflect the exposed coastal conditions at GATE.

Contacts: (all NPS-GATE) George Frame, Mike Byer, Kathryn Mellander, Steve Schiffer, Patti Reilly

Weather station, Great Kills Park, Staten Island

GATEWAY NATIONAL RECREATION AREA - JAMAICA BAY

Kathryn Mellander met me at Floyd Bennett Field. There is a defunct weather station consisting of a hygrothermograph and rain gauge at the nursery area. Mike Byer had showed me the records for this station at Staten Island, which consist of a two-inch thick stack of charts in a file drawer, with no electronic record, covering the period 1992-1994. There is also a basic weather setup at the ranger station (Building 135), by Davis Instruments, which showed wind speed, direction, and temperature, although the temperature sensor was not in a good location, hanging next to the wall outside and near an air conditioning unit. This is connected only to a display unit and not to a computer for data collection and storage. We met with Kim Tripp, Doug Adamo, and George Frame. There is an impressive amount of research ongoing at the Jamaica Bay Institute, and the only weather data they have, and feel they need, are from JFK International Airport. I also visited the NY Police Department's air station and inquired about weather data, but there are none - just a wind sock. Once again, there is no NADP site at this location.

Other sources: The Northeast Regional Climate Center, run by Cornell University, maintains weather and climate data for many stations, including one at JFK International Airport. I did not determine how the Jamaica Bay Institute acquires the JFK weather data. There are certainly many other sources for weather data in the greater New York City area, although these were not researched. It would be important to find sources that reflect the exposed coastal conditions at GATE.

Contacts: (all NPS-GATE) Kim Tripp, Doug Adamo, George Frame, Kathryn Mellander

Abandoned weather station, Floyd Bennett Field

Davis Instruments weather station at ranger station, Floyd Bennett Field

GEORGE WASHINGTON BIRTHPLACE NATIONAL MONUMENT

I met with Vidal Martinez and Rijk Morawe. Daily max/min temperatures were recorded and logged at the visitor center until the late 1980's, but at the present only rainfall is recorded. Temperature and humidity are major concerns for the innumerable cultural artifacts and buildings, which are open to the outside air. Some of the rooms have monitors and there are simple data loggers recording indoor conditions. As with many of these sites, fire management and habitat restoration are principal natural resource issues.

Other sources: About 12 miles to the north, also along the Potomac River, is the Dahlgren Naval Weapons Station, which has a weather station that measures max/min/avg temperature, relative humidity, wind speed/direction, and precipitation. I was unable to access these data. There also are typical fire weather data collected at Fredericksburg and Spotsylvania National Military Park, some 45 miles to the west.

Contacts: Vidal Martinez (NPS), Rijk Morawe (NPS)

Raingauge at visitor center, GEWA

Weather station at Dahlgren Naval Weapons Center, near GEWA

THOMAS STONE NATIONAL HISTORIC SITE

Rijk Morawe accompanied me, and was another resource manager from a largely cultural site that expressed great enthusiasm for natural resource values and monitoring. There are no known historic or current weather data collected.

Other sources: There are typical fire weather data collected at Fredericksburg and Spotsylvania National Military Park, approximately 60 miles to the southwest. Other sources, particularly from the Washington DC area, are probably available but were not researched.

Contacts: Vidal Martinez (NPS), Rijk Morawe (NPS)

ASSATEAGUE ISLAND NATIONAL SEASHORE

Assateague Island NS has a functional weather station with good data management. The weather station there is at km30 (south of Ocean City) and is a Handar/Vaisala 555B data logger, with the full array of sensors, transmitting data to the National Interagency Fire Center (NIFC) at Boise via a GOES satellite antenna. This station started out as a fire weather station, but was continued because of good upkeep even after it was realized that (prescribed) fire was not such an important issue in that area. The station dates back to 1992 and is maintained by a designated technician. The data go into an ACCESS database after they are received via the internet from the Weather Information Management System (WIMS) from Boise. There is data checking (for anomalies) by NIFC before they are sent back to ASIS. Cathy Galgano is the current database manager, and the data were previously managed by Mike O'Connell, now in grad school. Several of the sensors, including relative humidity, fuel moisture, and even the tipping bucket (rain gauge) mechanism are swapped out and sent in for calibration every 6 months. Instrument calibration is a very important issue, but I was surprised at the frequency (normal is 2 years). The tipping bucket mechanism was not at all easy to access or clean, although it was well screened for debris.

In addition to the weather station at km30, there are two rain gauges at the Visitor Center, and an NADP site as well.

As at Cape Cod, Jamaica Bay and elsewhere, there are many research and monitoring projects underway at Assateague Island. Much of the research and monitoring involves water quality, both on the bay side and the beach side. The weather station is located at about the midpoint of the park, which is a good location for a single station supporting a variety of park-wide research.

Other sources: There is a National Weather Service site at Wakefield, VA.

Contacts: (all NPS-ASIS) Carl Zimmerman, Cathy Galgano, Alex Almario, Mark Sturm, and Mike O'Connell (mioc160@hotmail.com)

Weather station, ASIS (2 photos)

COLONIAL NATIONAL HISTORIC PARK

Chuck Rafkind showed me the rather spread out and disjoint subunits of the park: Yorktown, Jamestown, the Colonial Parkway, and Colonial Williamsburg (managed by the Association for the Preservation of Virginia Antiquities). Needless to say, the distance and geographic differences among the subunits could be expected to correlate with a significant difference in weather patterns. For example Jamestown and Yorktown are separated by 26 miles and two rivers, and there are corresponding differences in air quality, tidal effect, and storm tracks. There are no weather data being collected at Colonial NHP at the present time, nor is there a NADP site. A Fire Management Plan is in the works, although fire is not a large issue in the park. The recent Hurricane Isabel did considerable damage to the park, with an estimated loss of over 10,000 trees, many of which we saw as we drove through the park. Stream flow is a great concern – the streams are well mapped, and weather data that relate to stream flow as well as seasonal ponds could be very useful.

Other sources: As with GATE, being in the middle of a highly urbanized area provides many possible sources for local weather data. The Virginia Chesapeake National Estuarine Research Reserve at the Virginia Institute of Marine Sciences collects continuous weather data. Other possible sources include the Naval Weapons Station at Yorktown, the College of William and Mary, the US Coast Guard, the National Weather Service site at Wakefield, VA, and perhaps some of the other universities and NPS historic sites in the area. The availability of data from these sources was not researched.

Contacts: Charles Rafkind (NPS-COLO)

CONCLUSIONS AND RECOMMENDATIONS

Network and Park Opportunities and Recommendations

There is relatively little weather data currently being collected within the Northeast Coastal and Barrier Network parks. Only one station, located at Assateague Island NS, has a high quality setup for a full range of standard weather parameters as well as quality controlled equipment and data management systems. There is also a setup at Cape Cod from which data on a few parameters is collected and stored on the WIMS website or a locally maintained computer. In addition, there is a good setup at Gateway's Staten Island Unit that could be repaired, and finally there is rain data collected at George Washington Birthplace NM. There are also National Atmospheric Deposition Program sites at both Cape Cod NS and Assateague Island NS. Other than the links to the WIMS system and the NADP program, there is currently no collaboration among parks for weather data, a natural result of the park-specific needs that the weather stations were meant to address.

The value of a more extensive and coordinated weather data collection and management program in the NCBN depends upon the specific objectives of park-specific and

Network-wide research and monitoring projects. It is beyond the scope of this assessment to determine this value, or to assess this value relative to the expected costs of such a system. Again depending upon the specifics of the projects, and the variation in local weather patterns, there may be opportunities to utilize some of the non-NPS sources of weather data that are available near many of the NCBN parks. If it is thought that weather data may be valuable for one or more of the vital signs monitoring projects, or other park-specific research or monitoring, it would be valuable to commission a report presenting a specific proposal for the installation and maintenance of a weather data collection and management system. Such a report should also include detailed equipment maintenance and data management protocols, and assess the following: specific opportunities to utilize non-NPS sources of weather data, the level of precision required to meet the long term objectives for collecting the weather data, and issues regarding the use of instruments of different makes and models.

Below are recommendations for the location of weather stations at each of the NCBN parks. In general this assumes that each park or park unit will be represented by one station, but site-specific stations could be installed in an area of intensive study or where particularly accurate local data is needed for a project.

- **Cape Cod National Seashore** – the NPS weather station at Truro is functional, but would benefit from better maintenance. Data from Provincetown and Chatham from NOAA could also probably serve for the extreme ends of the park.

- **Fire Island National Seashore** – a weather station could be installed (again) at Watch Hill, which is in the approximate middle of the island.

- **Sagamore Hill National Historic Site** – a weather station on the hill, perhaps located near the Superintendent's house, could be installed. Supplemental precipitation information from the marsh area could be collected with a simple forester rain gauge.

- **Sandy Hook unit of Gateway National Recreation Area** – a weather station near the residence/office area would serve this unit well. Alternatively, data from the NOAA setup at the Coast Guard station may be usable.

- **Staten Island unit of Gateway National Recreation Area** – the Davis Instruments weather station at Great Kills Park could be repaired and/or upgraded, depending upon project needs.

- **Jamaica Bay unit of Gateway National Recreation Area** – a weather station at Floyd Bennett Field could be installed, possibly as well as one at or near Great Egg Marsh (if it can be made secure).

- **George Washington Birthplace National Monument** – a weather station at the Maintenance Facility would be most useful.

- **Thomas Stone National Historic Site** - a weather station at the Maintenance Facility would be most useful.

- **Assateague Island National Seashore** – the existing weather station is in good shape, although the standards for data collection and equipment maintenance intervals could be reassessed.

- **Colonial National Historic Park** – there appear to be ample data available for the area around Yorktown (this was not investigated). A weather station at Jamestown would be valuable, probably sited at the Maintenance Facility.

Data, Equipment, and Personnel Guidance for an Integrated Weather Data System

Data Acquisition and Management

- All existing data, electronic or (especially) hard-copy, should be gathered and organized in either one secure central location at each park, or for the Network as a whole.

- Data should be stored at the park even if supplied to the NWS or other partners.

- Hard-copy data should eventually be put into an electronic database if and when feasible.

- Data need to be checked, at least for out of range values, and put in a well-organized database. EXCEL works well, but there are other options. The database manager needs to be familiar with the weather parameters being measured, and to have a feel for what the values should be. Instruments and software can fail in non-catastrophic ways that don't necessarily show up as out-of-range values.

- There are general problems with getting weather data off the internet: 1) data access and plowing through endless links and websites, 2) the confusing profusion of weather "products" available on-line, 3) the unknown reliability of the data, and 4) most important, the lack of geographic specificity to the park sites.

- Many, if not most, weather stations operated either by government or private organizations provide only real-time data. Very little of this data is logged and stored for archival purposes, which is essential for long-term ecological monitoring.

- NADP data probably exist from private operators, with the data available on-line.

Equipment Installation and Maintenance

- Installation of weather stations needs to be done with great sensitivity to access, security, (lack of) public view, resistance to animal and weather damage, and representation of the area climate.

- Weather stations need to be serviced/inspected on a regular basis for damage due to weather, animals, general wear and tear. Once every month or so is generally sufficient, although more frequent visits are better.

- Calibration of instruments is crucial – this usually only involves humidity and solar radiation sensors. Recommended intervals are on the order of every two years.

- It would be much more efficient and uncomplicated if all the weather stations were as similar as possible, especially as to the data logger and software. One familiar type that is used at Organ Pipe Cactus National Monument, where 11 automated weather stations have worked well for a number of years (see appendix). By coincidence, they all have the same data logger as the weather station at Assateague Island. This logger, the Handar/Vaisala 555, is apparently also a standard in many fire weather stations. At the moment, Handar/Vaisala offers free training at their Sunnyvale, CA facility. There are, of course, many other vendors.

Staffing

- Weather station personnel are highly encouraged to get training, either from the vendor or from qualified NPS staff.

- It would likely be necessary to have a designated technical expert available to the Network parks for field repairs, equipment calibration, troubleshooting, etc… This would potentially save a considerable amount of money, as well as time. The services that the equipment vendors provide can be quite expensive.

Appendix

Equipment and Price List for Typical Weather Station (such as at ORPI)

555A	Vaisala Data Collection Platform, Terminal Strip	$1703
CM10	10' tripod with mast and grounding kit	$345
ENC 12/14	weather resistant enclosure + mounting bracket	$230
555-7038	Internal Mounting Plate, 555A	$81
HMP45C	Vaisala Temperature and RH probe	$545
UT12VA	RM Young 12-Plate Gill Radiation Shield for HMP45C	$225
05103-L	RM Young Wind Monitor	$870
TE525WS-L	Texas Electronics 8" Tipping Bucket Rain Gage	$365
MSX10R	10 Watt Regulated Solar Panel	$410
BP12	12 A-hr Sealed Rechargeable Battery + Bracket	$95
LI200X	Li-Cor Silicon Pyranometer	$275
LI2003S	Li-Cor Base and Leveling Fixture	$55
015ARM	Pyranometer Mounting Arm	$75
TOTAL		$5274

This does not include computer for data storage, nor personnel costs. There is additional cost for some cable lengths, as well as minor hardware.